GLAST Calorimeter Muon Telescope Feb 11, 1999

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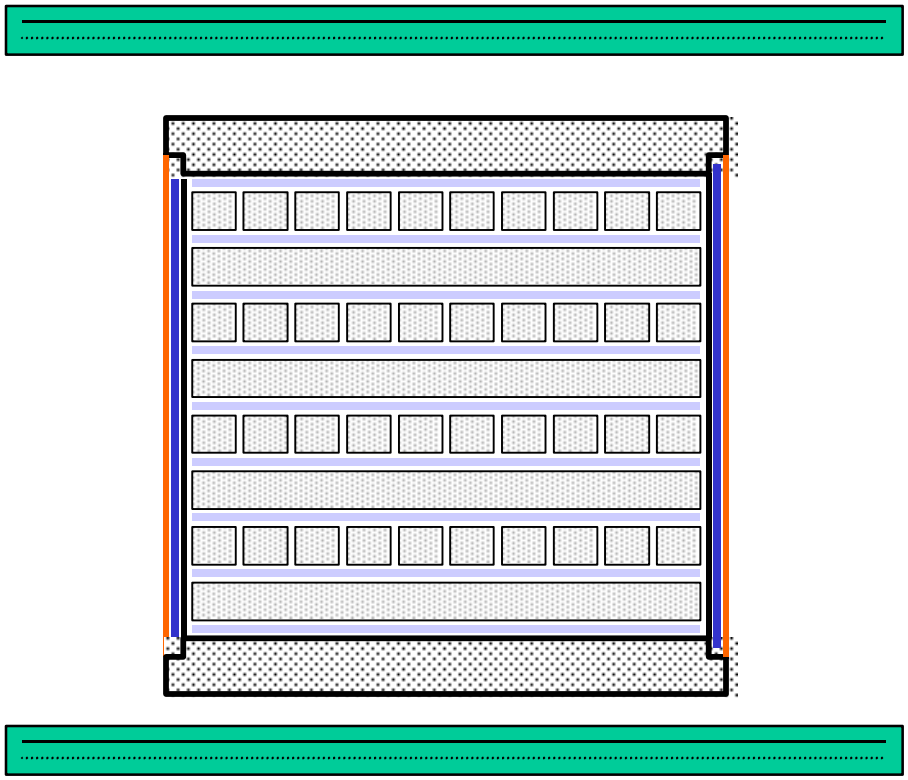
Goals

- To be able to track cosmic rays in the laboratory so they can be used to calibrate CsI crystals:
  - Energy deposition is ~ 10 times larger than using radioactive sources
  - much cheaper, easier than beam tests at accelerators
  - needed for testing 1000's of crystals
- Want simple and cheap mechanical and electronic design
- Want to accommodate largest possible crystals:
  - => 50x50 cm sensitive area
- Want position resolution much better than calorimeter imaging (4-5 mm rms)
  - spec 1 mm rms resolution (dynamic range of ~500)

Concept



* Plan to accommodate fully assembled calorimeter cells
* Use multi-wire proportional chambers with charge division

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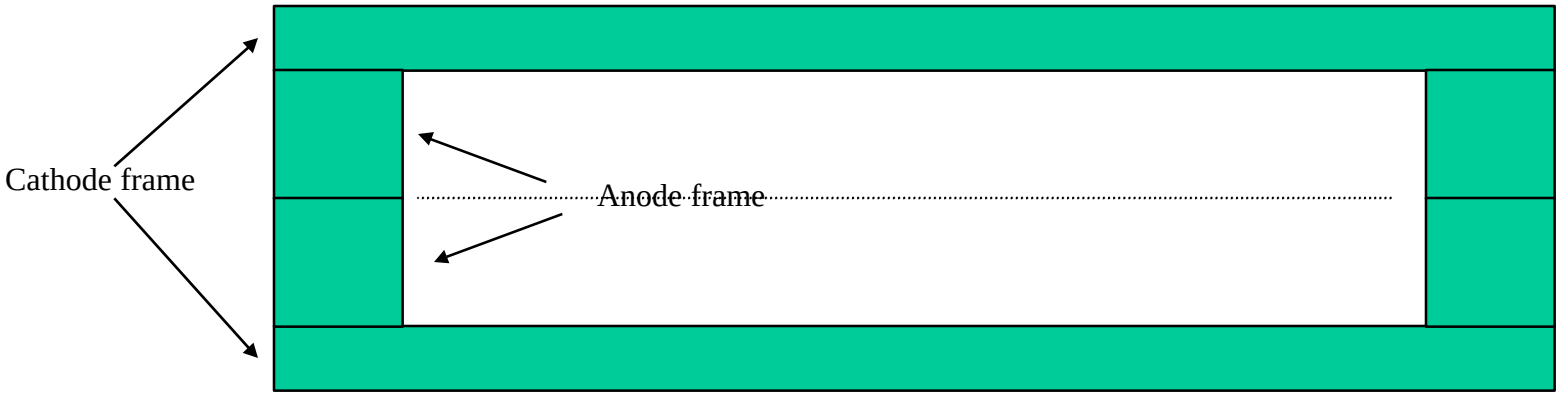
Chamber Construction



- Only 2 different types of frames:
  - cathode frames and anode frames
- mechanical frame is readout PCB (=> no machining)
- no individual wire readout, use charge division (=> 2 signals/position)
- Cathode frame is also window and collimator (for Fe-55)=> sturdy

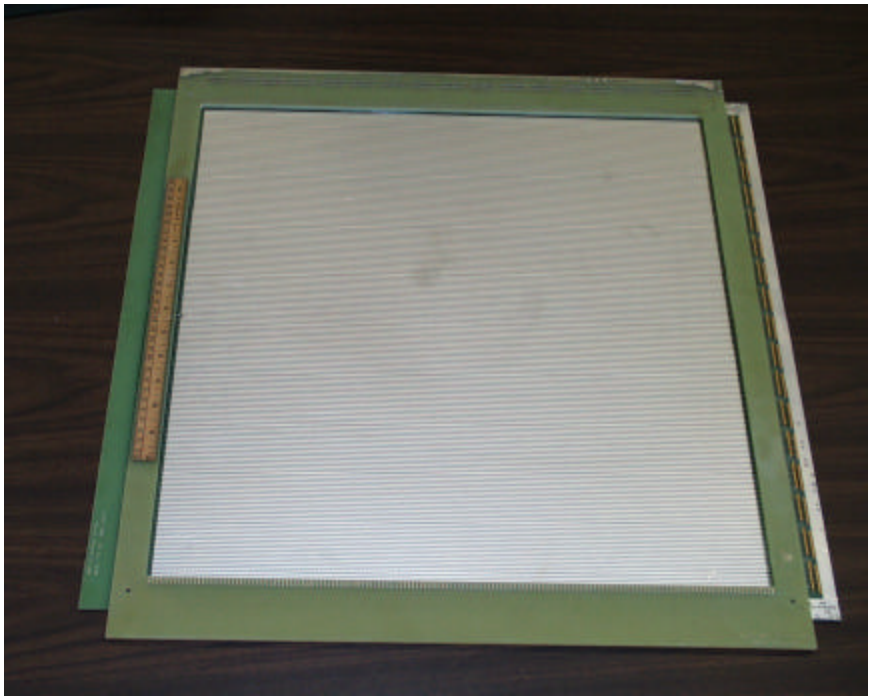
Chamber Construction (continued)

- One cathode is position sensing, one is trigger
- only one set of wires needed
- One anode frame holds wires, one is just a spacer
- Cathode frame is 1/8 inch PCB
- Anode frame is 1/4 inch PCB
- Chamber gas volume is ~ 50 x 50 x 1.27 cm
- Use Ar/CO2 mix (80 %, 20 %), for large amplitude signals
- Use 3 mm pitch on anode wires (25 micron Au-plated tungsten)
- Use 3 mm pitch on cathode pads
- High voltage is 2500-3000 V
- Use standard electronics (hybrid preamps, shapers, discriminators, ADCs and PC-based data acquisition system)

Cathode Board

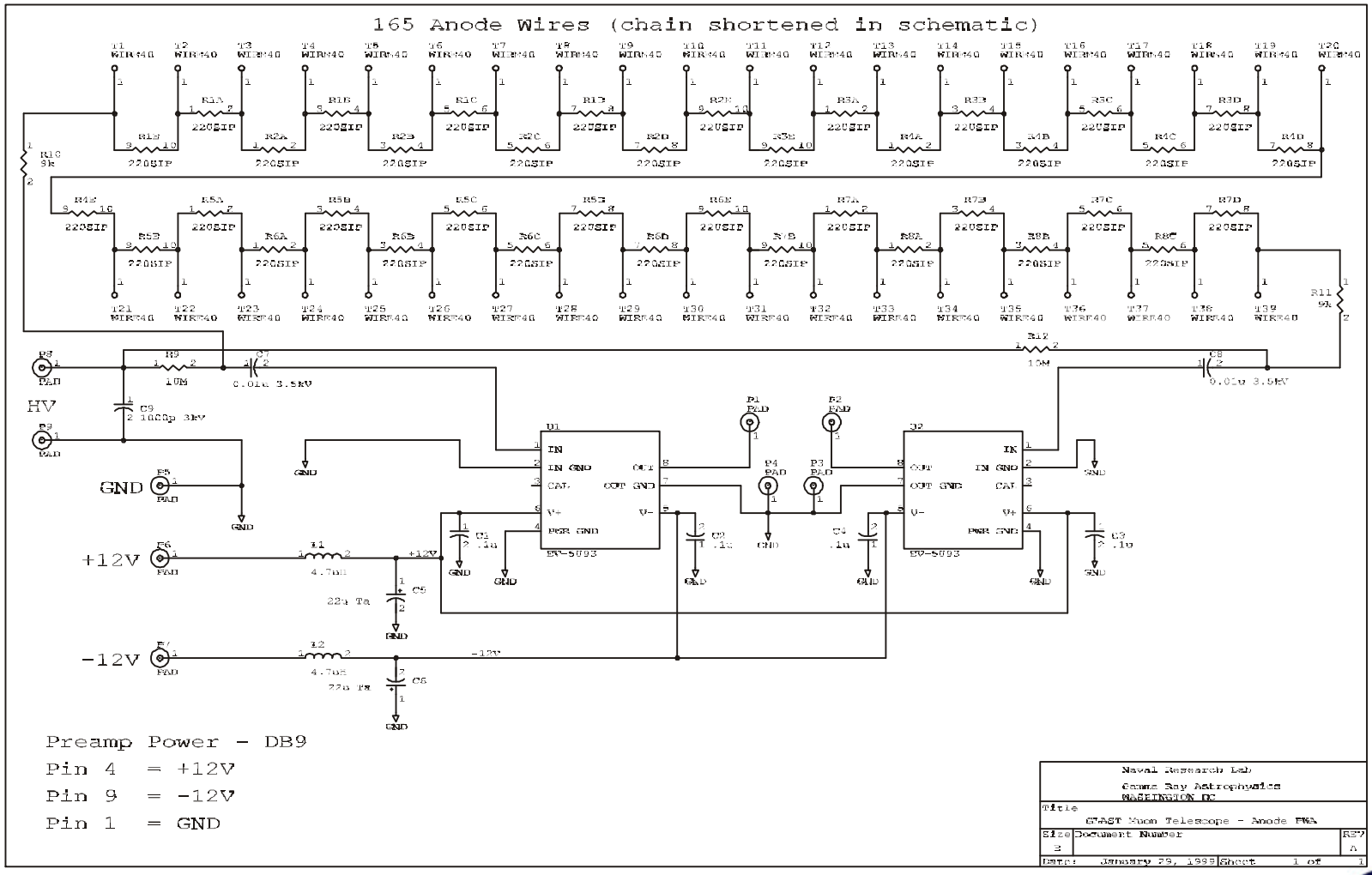
- Position sensing plane has resistors between pads (220 Ohms)
- Extra resistors at the ends (8 kOhms)
- trigger plane has all pads shorted
- ~1600 holes for Fe-55 calibration (tape them shut)
- electronics (including preamp) on same board

Anode frame

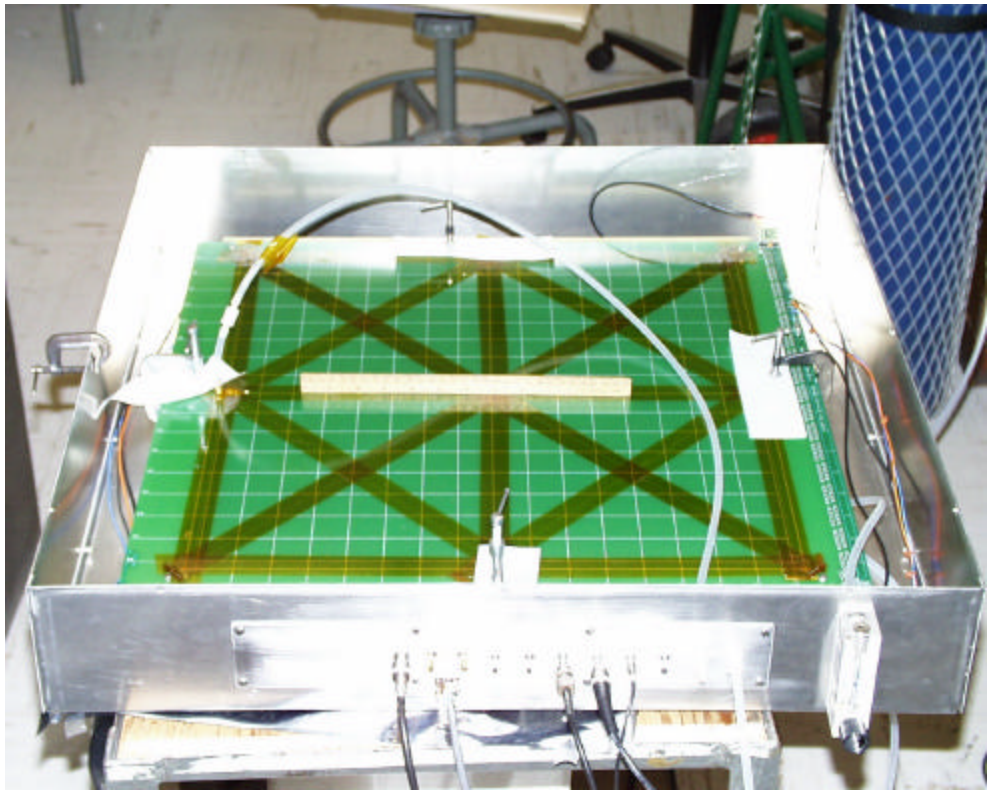


- 165 anode wires, with edge wire 50 micron in diameter
- frame is wider in direction of wires for mechanical strength (~ 20 lbs of tension)
- grooves in side for wire alignment
- electronics (including preamp) on same board

Circuit Diagram

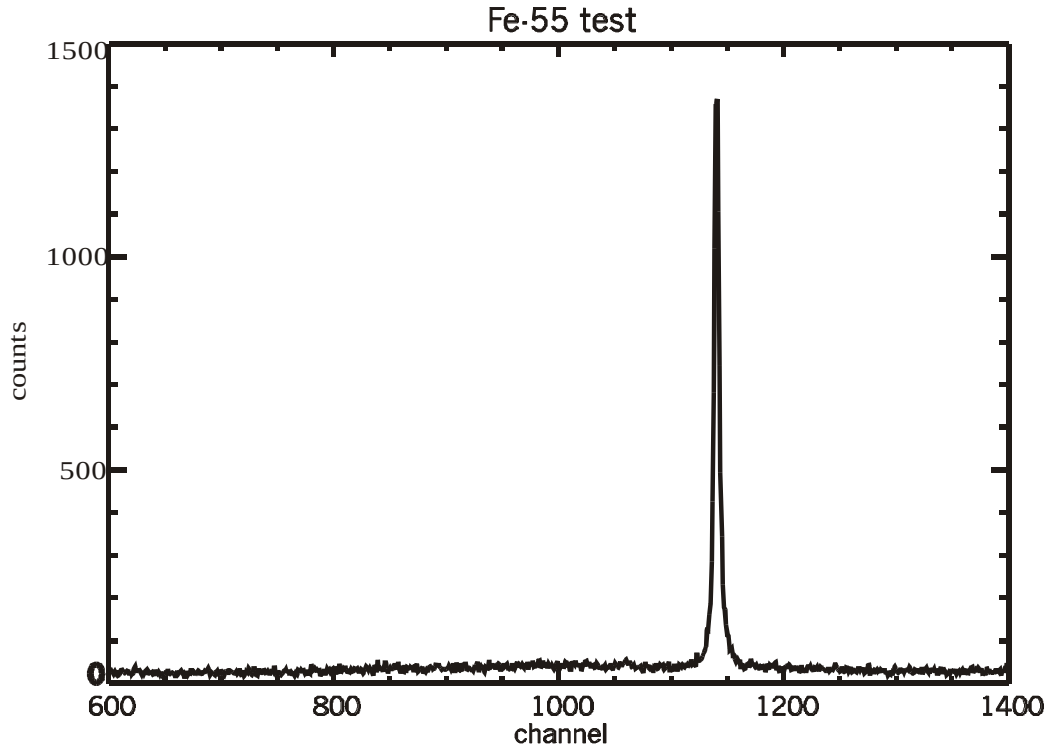


Prototype Chamber



- Only 4 signals for 2-d position (+1 for position-independent trigger)

Prototype position sensitivity



- Achieved < 1mm RMS with Fe-55 (using P-10 gas) at 2700 V
- Expect better resolution with cosmic rays in Ar/Co_2 at higher voltage (2800 V)